

November 1973

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This bibliography is taken from Technical Report No. 50, Green Space for Air Pollution Control, to be published in the Summer of 1973 by the School of Forest Resources, North Carolina State University, Raleigh, North Carolina, 27607.

The research was conducted between January 1, 1972, and February 28, 1973, under the helpful guidance of Dr. J. O. Lammi, Professor of Forest Resources, North Carolina State University.

The project was supported by the Triangle Universities Consortium on Air Pollution (comprising Duke University, North Carolina State University, and the University of North Carolina at Chapel Hill), which is funded by the Office of Manpower Development of the U. S. Environmental Protection Agency.

ABSTRACT

Green space is land covered with some form of vegetation - grass, shrubs, or trees. This report is particularly focused on that green space covered by woody vegetation, especially trees.

The role of plants and soil as sinks for air pollution and the filtering and sorption effects of vegetation on air pollution are reviewed. The effects of vegetation on the urban microclimate are discussed; a summary of meteorological factors to be considered in green space management is given. Management considerations for green space used for air pollution control include Russian, European and American experiences.

Airsheds, air zoning, air easements, land banking, transportation planning, and examples of man-oriented planning are integrated with the available basic research to serve as a guide for the management of green space for air pollution control.

The use of green space for control of an unique form of air pollution - noise - can be a concomitant objective of green space management for air pollution control. Factors influencing the transmission and absorption of sound by vegetation and the design of green space for noise abatement are discussed.

Based on what is known, a prototypical program of further research and development is presented. Basic and applied research needs are included.

SUMMARY

Green space can be a viable and efficient secondary, non-source means of air pollution control. With better dissemination of what is known about the effects of green space on air pollution, polluted environments can be enhanced by judicious use of woody vegetation.

Based on the available research and state of the art, the following guidelines for green space management for air and noise pollution control can be formulated. These are generally best adapted to the eastern half of the United States. Variations will be needed for drier and colder climates. Each situation must be evaluated utilizing localized meteorological, biological, topographical, and economic conditions.

Though no results can be guaranteed in the sense that some given amount of green space will reduce pollution by a certain percentage, these broad guidelines will improve the quality of the surrounding environment. Green space is not a prescriptive use but rather amenable to many diverse multiple uses which do not impair its ability to reduce air and noise pollution. Thus, if a particular planting does not effectively influence the air pollution in the area, that green space is not "lost" but can be utilized for many other socially beneficial uses, e.g., recreation, watershed protection, commercial forestry, urban wildlife, aesthetic enhancement.

Green Space Guidelines

1. For point sources of air pollution, e.g., factories or concentrated areas of polluting activities, forest strips should be planted to funnel prevailing winds into areas with the highest pollutant concentrations. The funneling passages between green space should be 100 to 120 m wide and should constrict as they approach the industrial area to increase wind speed and facilitate pollutant dispersal. No high buildings or other barriers should be allowed in these passages so that free flow of air is possible. As the passages leave the polluted area no residential areas should be allowed in their paths.

The greenbelts or forest strips should be parallel to the wind passages and the direction of the prevailing winds with seven or eight rows of trees 2.5 - 3.0 m apart. Intrarow distances should average 0.4 m for shrubs and 0.5 m for trees. These rows should be planted in a step-wise manner with the lowest trees next to the wind passage. Older trees should be intermixed with young, vigorous seedlings. The greenbelts should average 11-20 m high and 20-35 m in width. The width should depend on the types of pollutants present and may range up to 2,000 m.

2. For mobile, non-point sources of air pollution, green space adjacent to traffic corridors should be planted with trees and shrubs as close to the highway as safely possible. On multi-lane highways, forested areas should be left or planted in medians and interchanges after construction is completed. This green space should be at least 15-30 m in width with trees averaging 10-20 m in height. The maintenance of such areas should be cheaper than the present mowing and seeding operations.

3. To lower concentrations of gases denser greenbelts are needed than for reducing particulate concentrations. To remove both particulates and gases efficiently greenbelts should have a longitudinal axis perpendicular to prevailing winds. These barriers should be combined with green, permeable plantings which would be concentric around the pollution source and connected by radial strips. Similar heights and widths as noted in No. 1 above apply.

4. For year-round filtering of particulates and gases, conifers are better than deciduous trees. Where toxic levels of pollutants are often present, deciduous trees should be mixed with conifers to maintain a vigorous green space. For most situations locally adapted species should be used with the actual species depending on local conditions and resistance studies.

5. Green space used for air pollution control can also reduce noise. In rural areas with high-speed traffic, belts of trees 20-30 m wide with the edge of the belt 15-25 m from the center of the nearest traffic lane should be planted and maintained. Center rows should be at least 11-14 m high. In urban areas the belts should be 5-15 m wide and the edge of the belt should be 5-15 m from the center of the nearest traffic lane. Next to the highway shrubs 1.5 - 2.5 m tall should be used with backup rows of trees 4-10 m in height. As with air pollution control, greenbelts for noise control should be as close to the source of the pollution as feasible. Locally adapted species should be used with dense and relatively uniform vertical foliage where possible. Spacing should be as dense as biologically possible for the given species.

BIBLIOGRAPHYEXPLANATORY NOTE

Two separate computer assisted searches were completed. With the assistance of the Reference Department of D. H. Hill Library, North Carolina State University, in programming, the North Carolina Science and Technology Research Center did a computer search, Air Pollution and Urban Green Space. This search included the National Aeronautics and Space Administration (NASA) file, the Defense Documentation Center (DDC) file, and the Government Report Announcements (GRA) file. Ninety-two abstracts were obtained from this search with only 10 being directly relevant to this research.

The second computer search was done by the Air Pollution Technical Information Center (APTIC) of the Office of Air Programs, U. S. Environmental Protection Agency, Research Triangle Park, North Carolina. Five different approaches to their files were tried in an effort to obtain all relevant data. These searches covered 36,000 technical documents collected from 1,100 domestic and foreign journals and reports. The results were excellent, giving a much wider range of developments than the previous search by the North Carolina Science and Technology Research Center.

In addition to these computer-assisted searches, journals, abstracts, translations, and the National Air Pollution Control Administration reprint files at North Carolina State University were reviewed. Helpful assistance was offered by the U. S. Environmental Protection Agency Library at Research Triangle Park, North Carolina.

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APTIC: Air Pollution Technical Information Center
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